

WHAT IS CLAIMED IS:

1. A method of measuring absolute static pressure at one or more positions along the wall of a microfluidic device transporting a working fluid that is immiscible in a first selected gas environment, comprising:

(a) providing a first fluid conducting channel having an atmosphere provided by the first selected gas environment in a sealed environment and in communication with the microfluidic device at a first point of communication;

(b) providing a first sensing mechanism that is electrically interrogated, disposed adjacent to the first fluid conducting channel; and

(c) transporting the working fluid under pressure conducted by the microfluidic device into the first fluid conducting channel such that the volume transported into such first fluid conducting channel varies depending upon the absolute static pressure of the working fluid at the first point of communication, whereby the absolute static pressure at the first point of communication is electrically determined by the first sensing mechanism depending on the position of the interface of the working fluid and the first selected gas environment in the first fluid conducting channel.

2. The method of claim 1 further including providing a second fluid conducting channel and a second sensing mechanism disposed adjacent to the second fluid conducting channel and in communication with the microfluidic device at a second point of communication whereby the static pressure differential in the microfluidic device between the first and second points of communication is electrically determined by the first and second sensing mechanism.

3. The method of claim 1 further including at least one additional fluid conducting channel in direct communication with the first fluid conducting channel and providing an atmosphere by an additional selected gas in a sealed environment for such additional fluid conducting channel and an additional sensing mechanism disposed adjacent to the additional fluid conducting channel and wherein the additional selected gas environment associated with the

additional fluid conducting channel has a different volume to cross-sectional area ratio than the first selected gas environment in the first fluid conducting channel.

4. The method according to claim 1 wherein the first selected gas includes air, nitrogen, argon, neon, helium, oxygen, hydrogen, water vapor, carbon monoxide, or carbon dioxide or a miscible combination of these.

5. The method according to claim 1 wherein the working fluid includes water, ink, ethylene glycol, methanol, ethanol, isopropanol, oil, acetone, an organic solvent, a biological fluid, or a solution of a chemical analyte, or a miscible combination of these.

6. A method of measuring flow rate between two or more positions along a microfluidic channel transporting a working fluid that is immiscible in a first selected gas environment, comprising:

(a) providing a first fluid conducting channel having an atmosphere provided by the first selected gas environment under a sealed environment and in communication with the microfluidic channel at a first point of communication;

(b) providing a first sensing mechanism that is electrically interrogated, disposed adjacent to the first fluid conducting channel;

(c) transporting the working fluid under pressure conducted by the microfluidic channel into the first fluid conducting channel such that the volume transported into such first fluid conducting channel varies depending upon the absolute static pressure of the working fluid in the microfluidic channel at the first point of communication, whereby the absolute static pressure at the first point of communication is electrically determined depending on the position of the first interface of the working fluid and the first selected gas environment in the first fluid conducting channel when the first sensing mechanism is electrically interrogated;

(d) providing a second fluid conducting channel having an atmosphere provided by the second selected gas under a sealed environment and in communication with the microfluidic channel at a second point of communication;

(e) providing a second sensing mechanism that is electrically interrogated, disposed adjacent to the second fluid conducting channel;

(f) transporting the working fluid under pressure conducted by the microfluidic channel into the second fluid conducting channel such that the volume transported into such second fluid conducting channel varies depending upon the absolute static pressure of the working fluid in the microfluidic channel at the second point of communication, whereby the absolute static pressure at the second point of communication is determined depending on the position of the second interface of the working fluid and the second selected gas environment in the second fluid conducting channel when the second sensing mechanism is electrically interrogated;

(g) providing an additional fluid conducting channel having an atmosphere provided by an additional selected gas under a sealed environment and in communication with the microfluidic channel at an additional point of communication;

(h) providing an additional sensing mechanism that is electrically interrogated, disposed adjacent to the additional fluid conducting channel;

(i) transporting the working fluid under pressure conducted by the microfluidic channel into the additional fluid conducting channel such that the volume transported into such additional fluid conducting channel varies depending upon the absolute static pressure of the working fluid in the microfluidic channel at the additional point of communication, whereby the absolute static pressure at the additional point of communication is electrically determined depending on the position of the additional interface of the working fluid and the additional selected gas environment in the additional fluid conducting channel when the additional sensing mechanism is electrically interrogated;

(j) calculating the average static pressure gradient between any two of the points of communication by dividing the difference in absolute static

pressure measured at the two points of communication by the separation distance between the two points of communication; and

(k) calculating the flow rate of the working fluid through the microfluidic channel between any two of the points of communication from the average static pressure gradient between any two of the points of communication and the physical properties of the working fluid as function of the cross-sectional area of a microfluidic channel formed in the microfluidic device and the viscosity of the working fluid in the microfluidic device.

7. The method of claim 6 further including at least one additional fluid conducting channel in direct communication with the first fluid conducting channel and providing an atmosphere by an additional selected gas environment in a sealed environment for such additional fluid conducting channel and an additional sensing mechanism disposed adjacent to the additional fluid conducting channel and wherein the additional selected gas environment associated with the additional fluid conducting channel has a different volume to cross-sectional area ratio than the first selected gas environment in the first fluid conducting channel.

8. The method according to claim 6 wherein the first, second, and additional selected gases include air, nitrogen, argon, neon, helium, oxygen, hydrogen, water vapor, carbon monoxide, or carbon dioxide, or a miscible combination of these.

9. The method according to claim 6 wherein the working fluid includes water, ink, ethylene glycol, methanol, ethanol, isopropanol, oil, acetone, an organic solvent, a biological fluid, or a solution of a chemical analyte, or a miscible combination of these.